

## CLAIMS

We claim:

1. An apparatus for excluding objects from introduction into a controlled area, comprising:  
a portal structure with an opening for passage of a subject to be scanned;  
an array of magnetic field sensors mounted on said portal structure adapted to sense an induced magnetic field of an object in at least one sensitive axis;  
at least one excitation source establishing at least one magnetic excitation field adapted to induce said magnetic field of said object, said at least one excitation source being oriented to cause said at least one excitation field to have a substantially zero mutual inductance with said sensors; and  
a processor adapted to interpret signals from said sensors to indicate the presence of said object.

2. The apparatus recited in claim 1, wherein:  
each said sensor comprises a single magnetometer having at least one sensitive axis; and  
said at least one excitation source is oriented to cause said at least one excitation field to have a substantially zero mutual inductance with said at least one sensitive axis of each of said magnetometers.

3. The apparatus recited in claim 2, wherein said at least one magnetometer comprises an induction coil magnetometer.

4. The apparatus recited in claim 2, wherein said at least one magnetometer comprises a magnetoresistive magnetometer.

1           5.     The apparatus recited in claim 1, wherein each said sensor comprises a  
2 gradiometer including a pair of magnetometers, each of said magnetometers being  
3 oriented to have its said at least one sensitive axis parallel to said at least one sensitive  
4 axis of said other magnetometer of said pair.

1           6.     The apparatus recited in claim 5, wherein said at least one excitation  
2 source is oriented to cause said at least one excitation field to have a substantially zero  
3 mutual inductance with said at least one sensitive axis of each of said magnetometers.

1           7.     The apparatus recited in claim 1, wherein:  
2           said at least one sensitive axis of each said sensor comprises three sensitive axes;  
3           a first said sensitive axis is a horizontal axis lying substantially parallel to the  
4           plane of said portal structure;  
5           a second said sensitive axis is a horizontal axis lying substantially orthogonal to  
6           the plane of said portal structure; and  
7           a third said sensitive axis is a vertical axis lying substantially parallel to the plane  
8           of said portal structure.

1           8.     The apparatus recited in claim 1, wherein:  
2           said sensor array comprises first and second sub-arrays of said sensors;  
3           said first sub-array is arranged on the left side of said portal opening, relative to  
4           the path of said subject being scanned; and  
5           said second sub-array is arranged on the right side of said portal opening, relative  
6           to the path of said subject being scanned.

1           9.     The apparatus recited in claim 8, wherein said sensor array further  
2 comprises a third sub-array of said sensors arranged above said portal opening.

1           10.    The apparatus recited in claim 8, wherein said sensor array further  
2 comprises a third sub-array of said sensors arranged below said portal opening.

1           11.    The apparatus recited in claim 8, wherein:  
2           said sensor array further comprises third and fourth sub-arrays of said sensors;  
3           said third sub-array is arranged above said portal opening; and  
4           said fourth sub-array is arranged below said portal opening.

1           12.    The apparatus recited in claim 1, wherein said at least one excitation  
2           source comprises at least one permanent magnetic source.

1           13.    The apparatus recited in claim 12, wherein said at least one permanent  
2           magnetic source comprises a plurality of permanent magnetic sources, each said  
3           permanent magnetic source being arranged with its magnetic field orthogonal to each  
4           other magnetic field of said at least one excitation source.

1           14.    The apparatus recited in claim 13, wherein said plurality of permanent  
2           magnetic sources comprises at least two permanent magnetic sources, each said  
3           permanent magnetic source being arranged with its magnetic field orthogonal to each  
4           other magnetic field of said at least one excitation source.

1           15.    The apparatus recited in claim 14, wherein each said permanent magnetic  
2           source comprises at least two permanent magnets, each said permanent magnet having its  
3           magnetic field axis substantially parallel to the magnetic field axis of another said  
4           permanent magnet of said permanent magnetic source, said at least two permanent  
5           magnets of said permanent magnetic source being positioned on opposite sides of said  
6           portal opening.

1        16.    The apparatus recited in claim 15, wherein:  
2        said at least two permanent magnets of a first said permanent magnetic source  
3                have magnetic field axes substantially parallel to the plane of said portal  
4                structure, with at least one said permanent magnet being on the left side of  
5                said portal opening and at least one said permanent magnet being on the  
6                right side of said portal opening, relative to the path of said subject being  
7                scanned; and  
8        said at least two permanent magnets of a second said permanent magnetic source  
9                have magnetic field axes substantially parallel to the plane of said portal  
10               structure, with one said permanent magnet being on the top side of said  
11               portal opening and the other said permanent magnet being on the bottom  
12               side of said portal opening.

1        17.    The apparatus recited in claim 13, wherein:  
2        said at least one excitation source further comprises an excitation coil source;  
3        said excitation coil source comprises two excitation coils, each said excitation  
4                coil having its magnetic field axis substantially parallel to the magnetic  
5                field axis of the other said excitation coil of said excitation coil source;  
6                and  
7        said two excitation coils of said excitation coil source have magnetic axes  
8                substantially orthogonal to the plane of said portal structure, with one said  
9                excitation coil being on the front side of said portal opening, and the other  
10               said excitation coil being on the back side of said portal opening, relative  
11               to the path of said subject being scanned.

1        18.    The apparatus recited in claim 1, wherein said at least one excitation  
2        source comprises at least one excitation coil source.

1           19.     The apparatus recited in claim 18, wherein said at least one excitation coil  
2     source comprises a plurality of excitation coil sources, each said excitation coil source  
3     being arranged with its magnetic field orthogonal to each other magnetic field of said  
4     plurality of excitation sources.

1           20.     The apparatus recited in claim 19, wherein said plurality of excitation coil  
2     sources comprises three excitation coil sources, each said excitation coil source being  
3     arranged with its magnetic field orthogonal to said magnetic fields of the other two of  
4     said three excitation coil sources.

1           21.     The apparatus recited in claim 20, wherein each said excitation coil source  
2     comprises two excitation coils, each said excitation coil having its magnetic field axis  
3     substantially parallel to the magnetic field axis of the other said excitation coil of said  
4     excitation coil source, said excitation coils of said excitation coil source being positioned  
5     on opposite sides of said portal opening.

1        22.     The apparatus recited in claim 21, wherein:  
2        said two excitation coils of a first said excitation coil source have magnetic axes  
3               substantially orthogonal to the plane of said portal structure, with one said  
4               excitation coil being on the front side of said portal opening, and the other  
5               said excitation coil being on the back side of said portal opening, relative  
6               to the path of said subject being scanned;  
7        said two excitation coils of a second said excitation coil source have magnetic  
8               axes substantially parallel to the plane of said portal structure, with one  
9               said excitation coil being on the left side of said portal opening and the  
10              other said excitation coil being on the right side of said portal opening,  
11              relative to the path of said subject being scanned; and  
12        said two excitation coils of a third said excitation coil source have magnetic axes  
13              substantially parallel to the plane of said portal structure, with one said  
14              excitation coil being on the top side of said portal opening and the other  
15              said excitation coil being on the bottom side of said portal opening.

1        23.     The apparatus recited in claim 1, further comprising:  
2        a lock on a door to said controlled area;  
3        an interlock circuit between said processor and said door lock, said processor  
4               being programmed to control said interlock circuit to unlock said door  
5               lock only in the event of passage of a subject through said portal opening  
6               without said sensors sensing an induced magnetic field of an object.

1           24.    A method for excluding objects from introduction into a controlled area,  
2 comprising:  
3           providing an array of magnetic field sensors mounted on a portal structure;  
4           providing at least one excitation source;  
5           establishing at least one magnetic excitation field with said at least one excitation  
6                source, while orienting said excitation source to cause said at least one  
7                excitation field to have zero mutual inductance with said sensor array;  
8           scanning a subject with said sensor array;  
9           inducing a magnetic field in an object, with said at least one excitation field;  
10          sensing said induced magnetic field of said object, with said sensor array; and  
11          interpreting signals from said sensor array, with a processor, to indicate the  
12          presence of said object.

1           25.    The method recited in claim 24, wherein said at least one excitation source  
2 comprises an excitation coil, and further comprising energizing said excitation coil with  
3 alternating current.

1           26.    The method recited in claim 24, wherein said at least one excitation source  
2 comprises an excitation coil, and further comprising energizing said excitation coil with  
3 direct current.